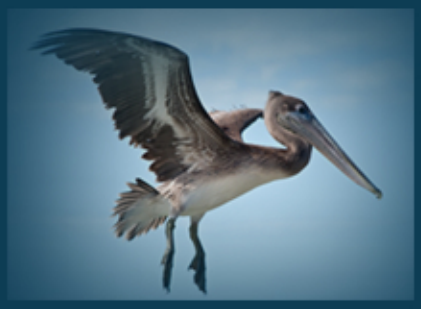

OCS Report
MMS 2009-015

Report to the Secretary,
U.S Department of the Interior

Survey of Available Data on OCS Resources and Identification of Data Gaps

Executive Summary

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Introduction

In response to President Obama's vision for energy independence for our Nation, Secretary of the Interior Ken Salazar announced on February 10, 2009, a four-part strategy for developing a new, comprehensive approach to energy resources of the Outer Continental Shelf (OCS):

(1) Extending the public comment period 180 days until September 21, 2009, on the Draft Proposed 5-Year Oil and Gas Leasing Program announced by the previous Administration.

(2) Development of a report by the Department's Minerals Management Service (MMS) and United States Geological Survey (USGS) on conventional and renewable offshore energy resources.

(3) Hosting four coastal regional meetings in April (Atlantic Coast, Gulf of Mexico, Pacific Coast, and Alaska) to review the findings of the USGS/MMS report and to gather input from all interested parties on whether, where, and how the Nation develops its conventional and renewable energy resources of the OCS.

(4) Expediting the Department of the Interior's (DOI's) renewable energy rulemaking for the OCS that was required under the Energy Policy Act of 2005 (EPAct), but which was never accomplished by the previous Administration.

The OCS refers to 1.7 billion acres of Federal jurisdiction lands submerged under the ocean seaward of State boundaries, generally beginning 3 geographical miles off the coastline (for most States) and extending for at least 200 nautical miles to the edge of the Exclusive Economic Zone and further as the continental shelf is extended. As the Secretary explained in his announcement, the DOI should establish an orderly process that allows us to make wise decisions based on sound information, in a way that provides States, stakeholders, and affected communities the opportunity to provide input on the future of our offshore areas.

This report is the result of the Secretary's directive to MMS and USGS, and has been prepared by the MMS in collaboration with the USGS. The report surveys information that is currently available regarding the nature and scope of offshore oil and gas and renewable energy resources on the OCS and identifies information regarding sensitive environmental areas and resources in the OCS. The report also identifies information gaps regarding available data on conventional and renewable resources on the OCS and environmental issues connected with OCS development.

The report's three main sections are: (1) renewable energy resources, (2) oil and gas resources, and (3) sensitive environmental areas and resources. They draw on information from technical reports and publications produced by the DOI bureaus, other Federal Agencies, academia, and the private sector. This document serves as a first step in summarizing information and identifying data gaps that may need to be addressed to make future informed decisions.

The information collated in this report regarding oil and gas resources has been drawn primarily from the 2006 report prepared by MMS, as directed by the EPAct. Information on OCS renewable resources has been drawn from a variety of sources including data collected from the U.S. Department of Energy, the National Renewable Energy Laboratory (NREL) , and other sources. Information on environmental issues was synthesized by MMS and USGS scientists based on the decades of research that has been conducted by MMS and USGS, as well as other Federal Agencies, universities, private industry, and research institutions.

As this report indicates, there are a number of important gaps in available data relating to all of these issues. The report, compiled in 45 days, does not purport to present new information or fill in existing data gaps. The primary purpose of the report is to present a survey of available data on the OCS so that the public and interested stakeholders can participate more effectively, and with greater access to potentially relevant information, in the public meetings on OCS development.

Energy Resources on the U.S. Outer Continental Shelf

The Outer Continental Shelf Lands Act (OCSLA) of 1953, as amended (Public Law, 43 U.S.C. 1331 *et seq.*), provides authority for mineral leasing on the OCS and guidance for balancing orderly oil and gas resource development with protection of the human, marine, and coastal environments. The OCSLA Amendments of 1978 established the requirement for developing an OCS oil and natural gas leasing program based on a 5-year cycle.

Section 388 of EPAct amended the OCSLA, giving the DOI discretionary authority to issue leases, easements, or rights-of-way for activities on the OCS that produce or support production, transportation, or transmission of energy from sources other than oil and gas, except where activities are already otherwise authorized in other applicable law. This authority was delegated to the MMS, which was charged with developing regulations intended to encourage orderly, safe, and environmentally responsible development of renewable energy resources and alternate use of facilities on the OCS.

The MMS has the lead role for developing wind energy on the OCS—leasing, exploration, development, production, and decommissioning. For hydrokinetic resources, the Federal Energy Regulatory Commission (FERC) is the lead for issuing licenses authorizing construction and operation of generating facilities. The MMS's role for hydrokinetic resources is to provide appropriate input to FERC's licensing process and to issue necessary leases, easements, and rights-of-way.

Renewable Energy

Estimating the potential of a given resource is a fairly straightforward process. However, it is often difficult to estimate the amount of renewable energy that is extractable or developable given the many uncertainties in societal preferences, technological developments, environmental sensitivities, transmission capacity, grid connection availability, and potential space-use conflicts in the ocean environment. Additionally, while certain geographic locations may possess economically developable resources and adequate transmission and grid capacity, the ultimate development of that potential is dependent on citizen interest and local, State, and Federal governmental policies.

Wind power is a renewable, low-carbon dioxide energy source located on the OCS that has the potential to become a significant source of electricity in the United States. Over the past two decades, land-based wind energy has seen a significant reduction in cost, making it a viable source for electric power generation in some areas of the United States. Offshore winds are typically stronger and more consistent than on land, and are frequently located near high-energy demand centers. Of the 48 contiguous States, 28 have a coastal boundary (including Great Lakes), and electric-use data show that these coastal States use 78 percent of the Nation's electricity.

Offshore wind resources have substantial potential to supply a large portion of the Nation's electricity demand (Figure 1). According to estimates by the NREL, developing shallow water (typically 0-30 meters) wind resources, which are the most likely to be technically and commercially feasible at this time, could provide at least 20 percent of the electricity needs of almost all coastal States.

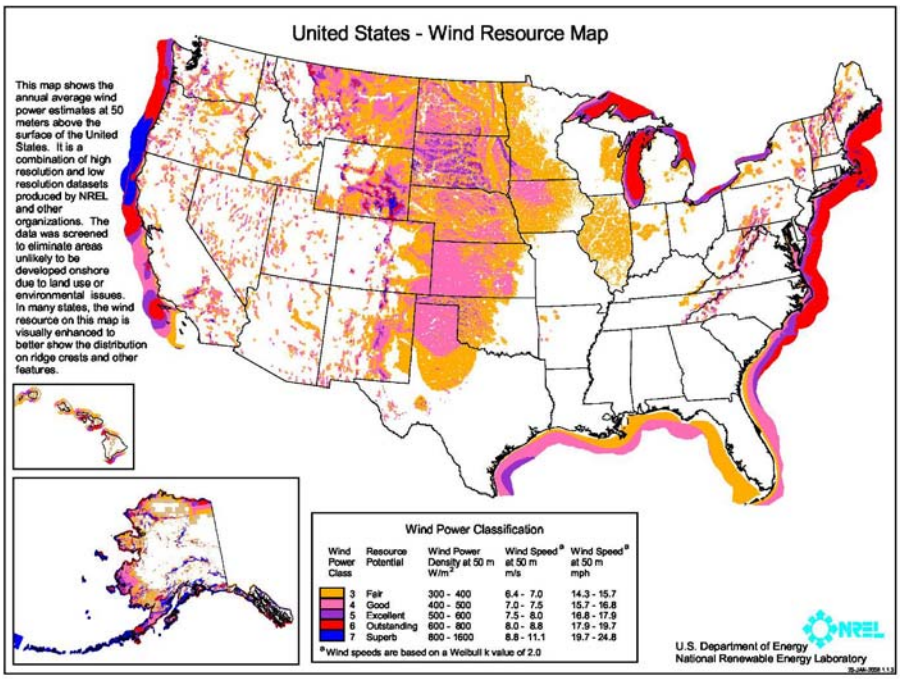

Figure I. United States Wind Resource Map (Source: NREL)

Wave energy also is a potentially significant OCS renewable energy resource, but wave energy is in the developmental stage. Given the current state of technology, the proximity to dense population and high energy load centers, and initial interest by select States, it does not appear that wave power is likely to become a major contributor to the national energy picture in the near future. Development is most likely to be focused in areas along the Pacific Northwest or off the coast of Hawaii.

Tidal energy technology development appears to be moving more quickly than wave energy technology development because its characteristics, such as predictable currents and location in shallow nearshore waters, make it more accessible to development. However, tidal projects typically occur close to the coast, within State boundaries.

Relative to wind, wave, and tidal energy, the resource potential for **ocean current power** is the least understood, and its technology is the least mature. The most viable potential opportunities for ocean current energy development in the United States are located off the southeast coast of Florida, in the Gulf Stream. However, analyses are incomplete at this time, so there may be other areas that have potentially viable current energy resources as well. To date, there is no comprehensive nationwide estimate on the current energy resource potential.

The Atlantic OCS has the greatest **renewable energy potential** relative to other OCS Regions in the Gulf of Mexico, Pacific, and Alaska. In the short-term (the next 5-7 years), this is most likely to be from offshore wind power. Substantial wind resources exist offshore the Atlantic Coast, near high-energy demand centers. Strong wind resources also exist offshore California, Oregon, Washington, and Hawaii, but it appears that the majority of this resource lies in deep waters where technology constraints are potentially significant. Alaska has outstanding ocean renewable energy resource potential. However, because of harsh weather conditions and significant distance from high-energy demand centers, it is not anticipated that these resources will be developed on the Alaska OCS in the short term.

Oil and Gas Resources

Oil and gas development in the OCS is, and will continue to be, an important component of our Nation's energy portfolio. In 2007, the OCS accounted for 14 percent (2,860 billion cubic feet) of the Nation's natural gas production and 27 percent (492,329,179 barrels) of its oil production. This production was from 3,795 production facilities on 8,124 MMS-administered leases, covering more than 43 million acres.

This report summarizes the results of a regional assessment of the entire U.S. OCS that was completed by MMS in 2006, as well as assessments of new areas identified for inclusion in the 2010-2015 Draft Proposed Oil and Gas Leasing Program.

It is important to recognize that estimates of undiscovered oil and natural gas resources are just that: *estimates*. Resource assessments are an attempt to quantify something that cannot be

accurately known until the resource has been developed and essentially depleted. The estimates presented in this report should be considered general indicators and not predictors of the absolute volumes of petroleum potential of the areas.

The MMS assessment of the hydrocarbon potential of the OCS is based on the analysis of published information and proprietary geologic, geophysical, and engineering data obtained by industry from operations performed under permits or mineral leases and furnished to the MMS. These estimates of undiscovered *technically* recoverable resources (UTRR) are subjected to a separate analysis incorporating economic and engineering parameters to estimate the undiscovered *economically* recoverable resources.

Regional-level UTRR results from the 2006 National Assessment are shown in Table 1. The estimates are presented as a range of estimates, and include the mean estimate and the 95th and 5th percentile levels. This range of estimates corresponds to a 95-percent probability (a 19 in 20 chance) and a 5-percent probability (a 1 in 20 chance) of there being more than those amounts of petroleum present, respectively. The 95- and 5-percent probabilities are considered reasonable minimum and maximum values, and the mean is the average or expected value.

Table 1. Undiscovered Technically Recoverable Resources of the OCS

Region	Oil (Bbo)			Natural Gas (Tcf)			BOE (Bbo)		
	F95	Mean	F5	F95	Mean	F5	F95	Mean	F5
Alaska OCS	8.66	26.61	55.14	48.28	132.06	279.62	17.25	50.11	104.89
Atlantic OCS	1.12	3.82	7.57	14.30	36.99	66.46	3.67	10.40	19.39
Gulf of Mexico OCS	41.21	44.92	49.11	218.83	232.54	249.08	80.15	86.30	93.43
Pacific OCS	7.55	10.53	13.94	13.28	18.29	24.12	9.91	13.79	18.24
Total U.S. OCS	66.60	85.88	115.13	326.40	419.88	565.87	124.68	160.60	215.82

(Bbo-billion barrels of oil; Tcf-trillion cubic feet of gas; BOE-barrels of oil equivalent. F95 indicates a 95-percent chance of at least the amount listed; F5 indicates a 5-percent chance of at least the amount listed. Only mean values are additive.)

The total hydrocarbon endowment of an assessment area is defined as the sum of historical production, current reserves, future reserves appreciation, and UTRR. As of the 2006 Assessment (Jan. 1, 2003, cutoff date), mean estimates of the OCS total hydrocarbon endowment were 115.4 billion barrels of oil (Bbo) and 633.6 trillion cubic feet (Tcf) of gas (a total of 228.2 billion barrels of oil equivalent [BBOE]). More than 18 percent of this total endowment (mean estimate barrels of oil equivalent [BOE]) has already been produced, and an additional 11 percent is contained within the various reserves categories, the source of near and midterm production. Notably, even after more than 50 years of exploration and development on the OCS, 70 percent of the mean BOE total endowment is represented by undiscovered resources. More than half of this potential exists in areas of the OCS outside of the Central and Western Gulf of Mexico.

An economic analysis follows the assessment of the UTRR and represents the portion of the mean UTRR that is economically producible under given engineering, commodity price, and

development cost scenarios. Results of this economic analysis are called Undiscovered Economically Recoverable Resources (UERR).

For the 2010-2015 Draft Proposed Program, UERR's were generated using oil prices of $60/barrel (bbl), $110/bbl, and $160/bbl. Results are shown in Table 2 and indicate that approximately 53 percent of the total UTRR is economically recoverable on an oil-equivalent (BOE) basis, with an oil price of $60/bbl and corresponding gas price of $6.41/thousand cubic feet of gas (Mcf). This increases to about 78 percent with an oil price of $160/bbl and corresponding gas price of $17.08/Mcf.

Table 2. Mean Undiscovered Economically Recoverable Resources of the OCS

Region	$60/bbl and $6.41/Mcf			$110/bbl and $11.74/Mcf			$160/bbl and $17.08/Mcf		
	Oil (Bbo)	Gas (Tcf)	BOE (Bbo)	Oil (Bbo)	Gas (Tcf)	BOE (Bbo)	Oil (Bbo)	Gas (Tcf)	BOE (Bbo)
Alaska OCS	4.45	7.20	5.73	11.45	30.01	16.79	15.46	50.78	24.50
Atlantic OCS	2.58	14.55	5.17	3.07	21.85	6.96	3.28	25.79	7.87
Gulf of Mexico OCS	36.75	165.94	66.28	41.04	203.43	77.24	42.56	214.87	80.79
Pacific OCS	8.38	13.16	10.72	9.29	15.14	11.98	9.49	15.60	12.27
Total U.S. OCS	52.16	200.85	87.90	64.85	270.43	112.97	70.79	307.04	125.42

(Bbo-billion barrels of oil; Tcf-trillion cubic feet of gas.)

New areas in the Atlantic, Eastern Gulf of Mexico, Pacific, and Alaska OCS have been identified for inclusion in the 2010-2015 Draft Proposed Oil and Gas Leasing Program. Although leasing has not occurred in these areas for about 25 years, previous exploration has occurred in portions of these areas, and some of these areas contain active leases with producing oil and gas fields. Updated research and exploration regarding the likely location of energy resources and environmental impacts are necessary to fill in data gaps.

Safety and the Environment

Oil Spill Risks

Oil spills are of major concern to the public, offshore industry workers, and Federal and State regulators. Spill prevention offshore is achieved primarily through required, extensive safety procedures and practices, and engineering requirements such as the use of downhole shut-off valves and blowout prevention devices. The record shows good results in preventing and minimizing spills. In 2003, the National Research Council reported (for the period 1990 through 1999) that offshore oil and gas development was responsible for only 2 percent of the petroleum found in the marine environment for North America. The MMS employs advanced oil-spill risk analysis to inform its environmental assessments of offshore activities. Spill prevention, mitigation, and response plans are required and tested frequently to maintain readiness offshore.

Geologic and Meteorological Hazards

Seafloor instability is the principle geologic hazard and, thus, engineering constraint to the emplacement of offshore bottom-founded structures. The MMS addresses and mitigates these hazards through the regulatory process. The MMS and USGS also conduct ongoing research that identifies and assesses hazards to offshore infrastructure.

The integrity of offshore infrastructure is also subject to changing ocean conditions and extreme weather events that generate intense winds, strong ocean and tidal currents, large waves, and heavy storm surges. With a large portion of OCS production located in an active hurricane corridor, many changes in industry requirements have taken place due to the recent damages and curtailment associated with hurricanes.

Global Climate Change

Uncertainty exists about the potential effects of global climate change on energy production and distribution, in part because the timing and magnitude of climatic effects are uncertain. An overarching concern for all coastal and marine areas is how environmental factors such as temperature, sea level, availability of water from precipitation and runoff, wind patterns, and storminess will be affected.

The Environmental Review Process

The environmental review process for renewable energy or oil and gas development activities includes compliance with various laws and regulations. The National Environmental Policy Act (NEPA) of 1969 requires that all Federal Agencies use a systematic, interdisciplinary approach that will ensure the integrated use of the natural and social sciences in any planning and decision making that may have effects on the environment. The goal of the NEPA process is to help public officials make decisions based on an understanding of potential environmental consequences and take actions that protect, restore, and enhance the environment. The MMS evaluates all aspects of the marine, coastal, and human environments including a detailed oil-spill risk analysis.

A tiered process has evolved for OCS oil and gas activities to evaluate the potential environmental consequences for each successive management decision starting with a proposed program, then individual lease sales, and finally project-specific plans. The 5-Year Programmatic Environmental Impact Statement analyzes the proposed leasing schedule, focusing on the size, timing, and location of proposed lease sales for the 5-year period identified in the proposed program document. Once the lease sale schedule is approved, more detailed environmental analyses are conducted for proposed lease sales in a given area. At that point, lease stipulations protective of the environment are identified and included in the leases granted to industry. After leases are issued, further environmental reviews of specific projects are conducted to ensure that the proper environmental protective measures are employed and site-specific mitigation measures are implemented. The mitigations may include, for example,

avoidance of sensitive biological communities and archaeological resources, or inclusion of specialized discharge requirements. It is anticipated that a similar tiered process will be used for renewable energy to ensure that each management decision has undergone an appropriate environmental review with input from stakeholders and the public.

Biological Habitats and Environmental Resources

Seafloor Habitats

An understanding of seafloor habitats is an important consideration in making leasing decisions. Some information is available on seafloor habitats for portions of the OCS, but there are significant data gaps for a number of areas. In some cases, exploration seismic surveys for oil and gas production, followed by required site-specific high-resolution "hazard" surveys, could provide detailed information about the seabed with regard to drilling hazards as well as for evaluating benthic habitats. In other cases, additional detailed, high-resolution mapping may be necessary along with ground-truthing with sediment samplers, remotely operated vehicles, or even submersibles in order to verify community makeup to allow for mitigation and avoidance of habitats.

Key challenges for renewable energy activities on the OCS are similar to those for oil and gas activities, such as evaluation for sensitive biological habitats. These activities are initially done through large-scale studies of a particular region using existing information if available, and subsequently site-specific higher-resolution mapping if necessary.

Coastal Habitats

Coastal habitats can be impacted by OCS development. In the Gulf of Mexico, for example, wetland losses have been associated with onshore energy infrastructure. Utilization of existing onshore facilities is a potential way to prevent further damage. Along the Pacific Coast, the heavily protected or developed coastline reduces options for pipeline or utility corridor sites required to support shore-based construction. While there are refineries and ports capable of supporting heavy industry, for the most part, the Atlantic region lacks existing onshore infrastructure geared to supporting offshore activity. Additionally, a significant portion of the coast, except portions of South Carolina and Georgia, are either developed or are State or federally protected shorelines. In Alaska, coastal environments are considered fragile; thus, it would be essential to accurately identify the sensitive habitats so they can be avoided by proper site selection and routing of support services.

Fishery Resources

Key challenges for oil and gas development that are common to all OCS areas include accidental oil spills, the threat of space-use conflicts, habitat alteration, and seismic surveys. The threat of oil spills and their direct and indirect effects on fisheries is central to the concerns about offshore oil and gas development. There is extensive information on the detrimental effects of oil on fisheries in coastal and ocean situations. Space-use conflicts, at the dock or offshore, and habitat alteration from pipeline installation are important challenges that should

be addressed by working closely with all interested stakeholders, encouraging multiple use of infrastructure and open consideration of alternative locations and routes. Seismic surveys are a challenge, as noise can negatively affect fishing activities and can limit access to an area. Seismic survey mitigations for fisheries include timing and notification so that there is the least amount of interference with fishing; avoidance of fish spawning locations, spawning seasons, and areas of concentrated fishing activity; limitation to the smallest area possible for the shortest amount of time; modifying frequency and duration of air-gun noise emission for least impact; and ramping-up so that sound energy emissions are gradually increased.

Key challenges for renewable energy development common to all OCS areas include offshore space-use conflicts, artificial reef effects, habitat alteration, noise from pile driving, and effects from electromagnetic fields (EMF). The MMS has funded research into the nature of space-use conflicts and offshore oil and gas structure siting, and is in the midst of a major study to delineate commercial fishing space-use conflicts for renewable energy. As with oil and gas, space-use conflicts for renewable energy activities are a challenge that should be addressed by working closely with all interested stakeholders. The artificial reef effect of offshore renewable energy structures will occur, and localized fisheries will likely change, becoming more or less attractive to fishermen. Noise from pile driving is localized, temporary, and potentially can be mitigated by the use of bubble-curtains, air gaps, and the quietest possible equipment and techniques. Habitat alteration, as power cables come ashore, potentially can be minimized by horizontal directional drilling and open consideration of alternative locations and routes. The subject of EMF continues to be studied globally, and MMS has an ongoing study to further address EMF. Mitigations for EMF include cable burial and proper shielding.

Marine Mammals

Overall, there is some baseline information available for predicting areas of likely presence and absence of marine mammals on the OCS. Information is available on some species (e.g., nearshore movements of baleen whales, bottlenose dolphins, and manatees) while data on other species are limited (e.g., offshore distribution of baleen whales, Arctic species). Effects for some activities are well understood (e.g., contaminants and marine debris, vessel strikes), while less known for others (e.g., anthropogenic noise, climate change).

One of the major challenges for OCS energy development activities to coexist with marine mammals is the issue of anthropogenic sound. Sound is of vital importance to marine mammals, and anthropogenic sound can temporarily or permanently impair their ability to process and use sound. Potential threats from noise include seismic airguns, explosive removals of structures, and pile driving. It appears that the use of ramp-up as a mitigation tool may reduce or prevent the sudden exposure of marine mammals to maximum airgun output levels, and allows for them to leave the immediate vicinity. More data are needed regarding impacts on marine mammals as a result of noise produced by OCS energy activities. Behavior impacts have been documented from traditional and renewable energy activities, although these types of effects are still not well understood. Other threats to marine mammals include marine debris such as lines from ships and garbage, vessel strikes, oil spills, contaminants, and construction activities.

Sea Turtles

Sea turtles are highly migratory with a wide geographic range. The key challenges for both renewable energy and oil and gas development in relation to sea turtles are similar to those for marine mammals, and include anthropogenic sound resulting from the use of seismic airguns, explosive removals of structures, and pile driving; the release of marine debris such as lines from ships and garbage; vessel strikes; oil spills and contaminants; and construction activities that disturb the bottom floor. The available information on sea turtle behavioral responses to sound levels from anthropogenic activities indicates that individuals are likely to actively avoid ensonified areas. However, the biological importance of behavioral responses to construction noise is unknown, and there is little information regarding short-term or long-term effects of behavioral reactions on sea turtle populations.

Marine and Coastal Birds

Large oil spills from oil and gas development activities could have a large impact to birds. The prospects for near-term wind energy developments off the mid-Atlantic coast of the United States has created concern about potential impacts of wind turbines on marine and coastal birds. In addition to legally protected species, millions of migratory birds traverse the Atlantic Flyway twice each year, and thousands more either nest on the Atlantic coast of the United States or overwinter in nearshore and offshore waters of the Atlantic OCS. The challenge is to locate and operate wind energy facilities in such a way as to minimize bird mortality.

Socioeconomics

Socioeconomic effects of the OCS program have been studied by MMS and others over many years. In addition to substantial revenues generated by offshore oil and gas development, the offshore oil industry is comprised of a great number of enterprises that provide innumerable goods and services in support of the exploration, development, and production of offshore oil in U.S. waters and abroad. Overall, an adequate baseline of information exists to address the socioeconomic effects of the OCS oil and gas program and the renewable energy program for leasing decisions. However, predictions of future industry activities are best built on past industry behavior. Therefore, as the renewable energy industry develops, new data on OCS operations will be needed to improve MMS estimates of the economic and demographic consequences.

Information Data Gaps

As we move into an era of renewable energy in some areas and the continued development of more traditional energy sources in others, our information base is not always complete. Additional geographically-based, targeted research will be required in some areas and for some disciplines. The data and information gaps identified in this report must be viewed in terms of a broad range of decisions – over broad geographic areas - that will need to be made in the future. Note too, that data gaps identified in this report will be supplemented with input from stakeholders at the Federal, State and community levels as regional and project-level decision making proceeds.

Renewable Energy Resources: Quantifying the potential offshore renewable energy resource is reasonably straightforward, and great strides are being taken to map the offshore wind, wave, and tidal resources. However, there is a high degree of uncertainty in estimating the actual extractable or developable amount of energy given the many uncertainties in societal preferences, technological developments, environmental sensitivities, transmission capacity, grid connection availability, and potential space-use conflicts in the ocean environment. Offshore renewable energy technologies are still developing, particularly for wave, tidal, and current power; and there is a need for standardized protocols and criteria in technical evaluation and design. Also, resource assessment methods for wave, tidal, and current energy are less developed compared to wind energy; resource assessments are incomplete; and the actual amount of developable energy is dependent upon a host of factors that need to be examined more closely.

Oil and Gas Resource Evaluation: Seismic surveys are the primary method of exploring for oil and gas. Most of the seismic data acquired in the potential new lease areas are more than 25 years old and may not be adequate for detailed prospect mapping or for lease sale bid formulation and evaluation, especially in geologically complex areas. New seismic and related data will likely be required for some areas (especially in the Atlantic OCS area and Eastern Gulf of Mexico) and is typically used by the oil and gas industry as part of their pre-leasing evaluation. Prior to acquisition of seismic data, NEPA and other environmental analyses may be required to better inform decisions.

Sensitive Environmental Areas and Resources: Overall, an adequate baseline of information exists to address the environmental effects of the OCS oil and gas program and the renewable energy program in support of leasing decisions. A key challenge in many areas will be to gather and synthesize existing information. In addition, new information is continually being gathered by MMS, USGS, and others. Once specific areas are identified for development, additional information may be needed for some biological resources. Some of the key information needs follow.

Seafloor Habitats: There are some areas with limited information, and additional site-specific high-resolution mapping may be required to allow mitigation and avoidance of sensitive biological habitats such as coral reefs.

Coastal Habitats: While there is a large information base that provides a general understanding of coastal habitats, these efforts do not always reflect the most recent conditions of coastal shorelines, where severe weather conditions and changes in sea level may be altering the area.

Marine Fish Resources: The key information need related to fisheries is that regarding potential space-use conflicts for commercial fishing, which requires identification of important fishing grounds.

Marine Mammals: Key information needs include increasing our understanding of: (1) specific life history traits and critical habitat areas for some key marine mammal species (i.e., important feeding, mating and nursing behaviors and habitat for baleen whales and Endangered Species Act-listed species); (2) potential effects from noise-producing activities; and (3) potential non-acoustic effects from renewable energy technologies (e.g., potential entanglement with anchoring array, large footprint of some facilities, and potential effects on migration).

Sea Turtles: Little is known about the effect of noise on sea turtles in the marine environment. In particular, their basic auditory system and hearing mechanisms or the role of sound in their life cycle are not well understood.

Marine and Coastal Birds: The existing information on seasonal distribution and abundance of marine birds is sparse. Such information is critical to understanding the potential for exposure to offshore wind energy developments and to analysis of collision risk.

Conclusion

While we continue to generate a vast majority of our electricity from fossil fuels, renewable energy sources appear more attractive as we look for ways to address environmental, economic, and energy security. The energy resources of the OCS, and specifically renewable energy sources, are particularly attractive options with significant resources located in close proximity to coastal population centers.

The experience, knowledge, and tools exist to ensure that offshore energy is developed in a comprehensive and environmentally sound manner. By obtaining stakeholder input (locally and nationally); compiling existing information and acquiring new data, where needed; conducting objective analyses using monitoring data to manage adaptively; and applying the necessary mitigations and safeguards along the way, we can achieve our national energy, economic, and environmental goals.

List of Terms Used in the Executive Summary

Probability*:* A means of expressing an outcome on a numerical scale that ranges from impossibility to absolute certainty; the chance that a specified event will occur.

Prospect: A geologic feature having the potential for trapping and accumulating hydrocarbons; a pool or potential field.

Reserves: The quantities of hydrocarbon resources anticipated to be recovered from known accumulations from a given date forward. All reserve estimates involve some degree of uncertainty.

Reserves appreciation: The observed incremental increase through time in the estimates of reserves (proved and unproved) of an oil and/or natural gas field as a consequence of extension, revision, improved recovery, and the addition of new reservoirs.

Resources: Concentrations in the earth's crust of naturally occurring liquid or gaseous hydrocarbons that can conceivably be discovered and recovered.

Total endowment: All technically recoverable hydrocarbon resources of an area. Estimates of total endowment equal undiscovered technically recoverable resources plus the EUR.

Undiscovered resources: Resources postulated, on the basis of geologic knowledge and theory, to exist outside of known fields or accumulations.

Undiscovered technically recoverable resources (UTRR): Oil and Gas that may be produced as a consequence of natural pressure, artificial lift, pressure maintenance, or other secondary recovery methods, but without any consideration of economic viability. They are primarily located outside of known fields.

Undiscovered economically recoverable resources (UERR): The portion of the undiscovered technically recoverable resources that is economically recoverable under imposed economic and technologic conditions.